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Differences in Sleep between Black and White Adults:

An Update and Future Directions

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Highlights

- We reviewed evidence on ethnic differences in sleep among black and white adults
- Objective data indicate black adults have poorer and less sleep than white adults
- Black adults have a higher prevalence of sleep-disordered breathing
- There is a lack of data on mechanisms that explain the ethnicity-sleep connection

- We propose a conceptual model of potential mediators for future investigation

Abstract

Meta-analyses and other previous reviews have identified distinct ethnic/racial differences in the quantity, quality, and propensity for sleep disorders between black and white adults. The present article reviews the meta-analytic evidence along with recent epidemiological, community, and clinical studies to clarify what is known and not known about sleep differences between these two groups. Black individuals tend to have poorer sleep continuity and quality, excessively short or long sleep duration, greater sleep variability, and greater risk for sleep apnea than white individuals. The data suggest that these differences are attenuated yet persist in the face of several, relevant confounders such as socioeconomic status, occupational factors, neighborhood context, and comorbidities, yet little is known about the mechanisms that explain ethnic disparities in sleep. We propose a conceptual model of potential mediators for future testing as well as other questions in need of investigation.

Keywords (6 max): race; black; disparities; sleep duration; insomnia; sleep apnea

Introduction

Sleep is a "fundamental requirement of living" according to the National Heart, Lung, and Blood Institute and the National Institutes of Health.[1] However, not all segments of society get sufficient quality, quantity, and consistency in their sleep. Ethnicity/race is a significant determinant of individual variation in sleep phenotypes. Some ethnic groups represent the extremes of this variation more than others suggesting significant ethnic inequities in sleep. A 2011 NHLBI workshop on "Reducing Health Disparities: The Role of Sleep Deficiency and Disorders" recommended that research should be conducted to foster a better understanding of these sleep disparities across ethnic/racial groups.[1] In concert, the National Center on Sleep Disorders Research stated in its 2011 strategic research plan that an objective for future research should be to "identify interactions between genes, endophenotypes and environment including . . . ethnic, socio-economic, cultural . . . factors associated with predisposition to, or modified disease course . . . of sleep and circadian disorders."[2] Blacks in the United States appear to be a particularly vulnerable minority group to sleep health disparities. Along with numerous other health disparities experienced by this group,[3] differences in sleep between blacks and other ethnic/racial groups in the United States have been increasingly reported in the last couple decades.

Some of the early work in this field includes an epidemiological study of ethnic differences in sleep across the adult lifespan and a narrative review on ethnic differences in sleep between black and white adults. The study consisted of 772 community members (~30% black) who contributed sleep diary data.[4] Of those who did not complain of any sleep difficulties, blacks reported longer sleep-onset

latencies (i.e. reported time spent to fall asleep) and greater nap durations. Blacks also had poorer sleep efficiencies (i.e., percentage of time slept during the time spent in bed attempting to sleep), but this was only significant among young adults. Older black adults slept significantly longer than older white adults. Among participants who met quantitative criteria for insomnia (i.e., sleep-onset latency or wake after sleep onset of ≥31 min for ≥3 nights per week for ≥6 months),[5] the prevalence of insomnia did not significantly differ between black (n = 40) and white (n=90) individuals (~17%). However, differences emerged at various points across the lifespan. Young (<30 years) and older (>70 years) whites had a higher prevalence of insomnia than blacks, whereas blacks had a greater prevalence during middle-age (ages: 30-59). Insomnia severity, as measured by diary-reported sleep efficiency, was relatively equivalent between the two ethnic groups in young adulthood, but differences grew and became significant over the age-span with greater severity among blacks. The narrative review of 28 relevant articles found similar results. The review concluded the sleep of young to middle-aged blacks is more disturbed than whites within the same age groups, and included the following features: longer time to sleep onset, greater risk for sleep-disordered breathing, greater nap frequency and duration, lighter sleep (i.e, greater percentages of Stages 1 and 2 sleep), and poorer, reported sleep quality.[6]

To quantify the magnitude of these initial reported differences, previously published meta-analyses on ethnic/racial differences in normal and disordered sleep were conducted on studies with white and black participants.[7,8] The present review will discuss the results of these meta-analyses in detail, their implications and weaknesses, several articles that have emerged since these meta-analyses were published, and directions for future research. Throughout the review we use the terms 'black' and 'white' exclusively. Though some of the studies discussed use other terms to describe the ethnic/racial groups, we opted to use the terms 'black' and 'white' to encompass all of the possible individuals included in the studies reviewed ('black' may refer to 'African American,' 'Caribbean American,'

'African,' or 'non-Hispanic blacks,' whereas 'white' may refer to 'non-Hispanic white,' 'Caucasian-American,' or 'individual of European descent.').

Previous Meta-analyses

The first meta-analysis published focused on ethnic differences in black and white adults on 'normal sleep' or sleep of individuals with no sleep disorders or complaints.[8] Fourteen studies, published before May 2009 that reported on objective or self-reported sleep parameters, were included. The number of participants in total per ethnic/racial group were approximately 1,000 blacks and 3,000 whites. Black individuals slept objectively worse (as measured by either polysomnography or wrist actigraphy) than whites. They had shorter sleep duration, less slow wave sleep percentage, greater stage 2 percentage, and poorer sleep efficiency (see Table 1 for a summary of effect sizes from this meta-analysis). Blacks also self-reported shorter sleep duration. There were no differences in percentage spent in REM or Stage 1 as well as objectively-measured wake after sleep onset.

Sleep duration and continuity (i.e., sleep efficiency, sleep-onset latency, and wake after sleep onset) were moderated by biopsychosocial factors including age, sex, body mass index, mental health status, medication use, employment status, and assessment location (laboratory vs. in-home), whereas none of the factors assessed moderated the sleep architecture (i.e., sleep stages) differences. Differences in self-reported sleep duration were greatest among the young to middle-aged, those with high body mass index, and among women. Differences in objectively-measured sleep continuity between blacks and whites were also greater among women, participants taking any medication, those evaluated at home, or likely had poor mental health. Shorter, objectively-measured sleep duration among blacks was most pronounced when measured at home, among samples with variable employment status, and participants taking medication or likely had poor mental health. Collectively, these data suggest that ethnic differences in sleep duration and continuity are most substantial among younger to middle-aged black women who may have suboptimal physical and mental health, variable

employment status, and have a disruptive sleep environment at home. Although socioeconomic status was not assessed as a moderator in this meta-analysis, all of these variables generally are correlated with low socioeconomic status suggesting ethnic/racial differences may be substantially explained by the higher prevalence of poverty and other social problems among blacks relative to whites.

The meta-analysis on disordered sleep explored ethnic differences in sleep-disordered breathing prevalence and severity, insomnia symptoms (i.e., difficulty initiating sleep, difficulty maintaining sleep, early morning awakeneings), and sleep complaints between black and white adults.[7] Ten studies, published prior to May 2009, presented data on ethnic differences in sleep-disordered breathing prevalence and severity whereas 13 studies provided data on sleep complaints and insomnia symptoms. Total sample sizes for any given sleep parameter ranged from 800 individuals to more than two million. Sleep-disordered breathing was more prevalent and severe in blacks than whites (see Table 1 for effect sizes). In addition, these black individuals also suffered from shorter objectively-assessed sleep duration. Although age, sex, and body mass index are major predictors of sleep disordered breathing risk, did not moderate the findings. Likely other moderators are acting on these relationships that were not measured in this meta-analysis. Whites reported more sleep complaints, difficulty maintaining sleep, and early morning awakenings than blacks (see Table 1 for effect sizes). There was no difference in difficulty initiating sleep. These sleep parameters were variously moderated by age, sex, and general medication use. The differences in difficulty maintaining sleep and early morning awakenings reduced with age. Since sleep tends to become more fragmented with age, it is likely older black individuals report more insomnia symptoms to approximate the same level of reporting as whites.

Recent Studies on Ethnic/Racial Differences in Sleep

The meta-analyses were a starting platform for exploring the presence, magnitude and meaningfulness of differences in sleep between blacks and white adults. Several articles have emerged since the completion of these meta-analyses as well as notable studies that did not meet inclusion

criteria for the meta-analyses that have expanded the field considerably. The articles and their implications are described below by sleep disorders and symptoms as well as other sleep parameters.

Sleep-disordered breathing prevalence, severity, and treatment adherence

The meta-analysis by Ruiter et al. on disordered sleep confirmed the presence of an ethnic disparity in sleep-disordered breathing between blacks and whites.[8] Though the magnitude of this difference was small (Hedges' g = 0.13), none of the major risk factors for sleep-disordered breathing moderated the difference and the sample size was quite large indicating the difference in the number of cases was substantial. Although moderator analyses were not able to be conducted, due to the homogeneity of the samples, there could be segments of the general population that were not adequately captured in the meta-analysis such as 'old-old adults' or a larger more representative sample of women. In a study of community-dwelling older men (75+ years), black race did not confer an increased odds of sleep-disordered breathing (OR: 1.05, 95%CI: 0.66-1.68),[36] therefore, ethnic differences may diminish with extreme age. Another study from a large single-site cohort of black adults found that risk for obstructive sleep apnea, one of the most common sleep-related breathing disorders, was 3.5% among men and 16.8% among women.[69] This prevalence among black men was comparable to prevalence rates among white men (4%) whereas the prevalence among black women is substantially larger than for white women (2%).[70] None of the aforementioned data described captured actual ethnic differences in physician-diagnosed sleep apnea. In the 2010 National Sleep Foundation poll, not surprisingly, blacks were also more likely to be diagnosed with sleep apnea than whites (14% vs. 6%).[11]

Based on a smaller number of heterogeneous samples, black and white differences in sleep disordered breathing severity in the meta-analysis, as measured by the apnea-hypopnea index, were more tentative. The fragility of that result is highlighted in a recent study on individuals diagnosed with obstructive sleep apnea which found no differences in the apnea-hypopnea index between blacks and whites (blacks: *M* = 42.99, *SD* = 3.42 vs whites: *M* = 41.87, *SD* = 3.66).[37] Regardless of whether sleep

apnea is more severe in blacks than in whites, continuous positive airway pressure (CPAP) treatment is available to correct that difference. Unfortunately, initial evidence suggests that adherence to CPAP was significantly lower in blacks than in whites despite standardized access and care within a clinical trial.[38] Average nightly use of CPAP over a three month period differed by an hour and a half (179 vs. 267 min).

Insomnia symptoms, insomnia, and sleep medication use

The number of participants within the studies cited in the meta-analysis on insomnia symptoms was quite large. Data that has been published since corroborates the findings of the meta-analysis. From the National Health and Nutrition Examination Survey (NHANES; 2007-08), blacks were significantly less likely to report difficulty maintaining sleep (OR: 0.82, 95%CI: 0.68-0.98), and early morning awakenings (OR: 0.80, 95%CI: 0.66-0.96).[26] Blacks were more likely to report sleep-onset latencies of greater than thirty minutes (OR: 1.59, 95%CI: 1.25-2.01), but contrary to this result they were less likely to report difficulty falling asleep compared to whites (OR: 0.56, 95%CI: 0.46-0.69). In the Sleep Heart Health Study, middle-aged to older adults did not demonstrate significant differences in the presence of insomnia symptoms between blacks (28%) and whites (30%).[32] Although, blacks with insomnia symptoms demonstrated lower physical and mental health-related quality of life than whites.

Actual physician-diagnosed insomnia is a different story. Data from NHANES 2005-2006 survey revealed that insomnia was diagnosed more often in blacks than in whites (1.5% vs. 0.8%) despite the increased odds of difficulty maintaining sleep among whites (OR: 0.8, 95% CI: 0.7-0.9).[25] In contrast, a national poll found whites were diagnosed with insomnia more often than blacks (10% vs. 3%).[11] Either way these data suggest that insomnia is substantially underdiagnosed in both groups. Two small samples of college students completed standardized screening questionnaires for insomnia.[33,34] There were no significant ethnic differences in risk for insomnia between black and white college students, though one of the studies reported the difference approached significance with whites reporting

insomnia more than blacks (12% vs. 9%; $\chi^2(1) = 3.05$, $p = .08$) .[33] Therefore, although there appears to be differences in reporting of insomnia symptoms, there may not be differences in actual insomnia rates.

The higher prevalence of reported insomnia symptoms among whites is also reflected in sleep medication use prevalence. Ram and colleagues found that white adults were far more likely to report taking sleeping pills or other medications to help their sleep than black adults (OR: 0.60, 95% CI: 0.4-0.8).[25] Among 1,910 middle-aged to older individuals with reported sleep problems, racial differences in self-reported current use of prescription, nonprescription, herbal, and other medications for sleep were examined.[35] In adjusted models, whites were more likely to use any sleep medication (35% vs 25%) as well as any type (prescription: 19% vs 14%; nonprescription: 10% vs 13%). These differences were dominated by women in the sample (38% vs 26%) for any type of sleep medication. In addition, blacks reported less frequent insomnia symptoms and more frequent insufficient sleep compared to whites; however, these differences did not reach statistical significance. In contrast, a national poll found no significant differences in sleep medication use no matter the type between black and white individuals (Prescription: blacks = 6% vs. whites = 11%; Over-the-counter: blacks = 14% vs. whites = 21%).[11]

Other sleep disorders

The literature on ethnic differences in other sleep disorders is minimal. Data thus far are mixed on the reported prevalence of restless legs syndrome (RLS).[11,25,34,39] Among community-based participants, there does appear to be a higher prevalence of clinically significant periodic limb movements (PLMSI > 15) as measured by polysomnography among whites than blacks (9.3% vs. 4.3%).[40] Yet there was no ethnic difference in the periodic limb movement arousal index in a study of menopausal women suggesting differences may depend on gender, age, and menopausal status.[16] The possibility of a greater prevalence of RLS and PLMS among whites may arise from the lower levels of iron ferritin levels (a known predictor of these symptoms)[41] in whites relative to blacks.[42]

Self-reported sleep duration.

Recent US-based, epidemiological surveys have included components on self-reported sleep. Habitual sleep duration was the most common variable included in these surveys. Sleep duration was reported by participants in the Americans' Use of Time Survey, which was conducted multiple times from 1975 to 2006. Knutson et al. investigated whether the prevalence of self-reported short sleep duration, study-defined as <6 hours, had increased over this time frame and what sociodemographic factors predicted short sleep duration.[9] They concluded that the presence of short sleep duration had significantly increased in the overall sample. When stratifying the sample by sociodemographic factors they found the odds of short sleep duration was higher for blacks than all other racial groups and that the presence of this difference was consistent across the 31-year study timeframe. Similarly, an analysis of the Alameda County Health and Ways of Living Study found that the odds of short sleep, study defined as< 7 hours, were greater among blacks at each of five time-points from 1965 to 1999 (OR: 1.97, 95%CI: 1.68-2.30), and that the difference widened over time (blacks: 26% to 54% vs. whites: 15% to 25%; p<.0001).[10] According to a national poll, this difference appears to be most salient on workdays or weekdays with blacks reporting they acquire 38 minutes less sleep than whites.[11]

These data are supported by several other national and community surveys including the 1990 National Health Interview Survey (NHIS), which found blacks had a greater odds for both short (≤ 6 hours; OR: 1.41, 95%CI: 1.27-1.57) and long sleep (≥ 9 hours; OR: 1.62, 95%CI: 1.40-1.88) after controlling for sociodemographic and economic factors, health behaviors, activity limitations, and urban environment status.[12] An analysis of a more recent NHIS (2004-2007; n = 110,441) replicated the greater odds of very short (≤ 5 hours; OR: 2.00, 95%CI: 1.84-2.17), short (6 hours; OR: 1.54, 95%CI: 1.44-1.65) and long sleep (≥ 9 hours; OR: 1.72, 95%CI: 1.59-1.87) durations among blacks compared to other ethnic/racial groups.[13] Only age and alcohol consumption were adjusted for in these analyses. However, the 2005 examination data were specifically examined for sleep duration differences while adjusting for multiple sociodemographic and socioeconomic factors, health behaviors, and medical conditions.[14] Once

again, black individuals had significantly greater odds of both very short (≤ 5 hours; 11.0% vs. 7.8%) and long (≥ 9 hours; 11.0% vs. 8.5%) sleep duration than other groups (OR: 1.35, 95%CI: 1.24-1.47).

Several potential confounders were proposed in all of these studies to explain the differences. Socioeconomic status, occupational variables, and neighborhood context are discussed below.

Socioeconomic status, one of the most popular proposed confounders, was most often represented by income and/or education. All of the aforementioned, recent studies controlled for these variables and the ethnic difference in self-reported sleep duration was attenuated but remained. For example, in one study the difference was diminished by 32% when controlling for household living conditions, income, and education.[10] Similarly, studies of smaller samples using polysomnography or wrist actigraphy discovered that differences in objective sleep duration were still statistically significant when income, education, and financial strain were included in the models.[15-17] For example, in a small sample of healthcare workers who were assessed with wrist actigraphy, after controlling for education and income, the ethnic/racial difference in sleep duration was reduced from 64.4 to 50.9 minutes on average, but nonetheless was still significant.[17]

Employment status was a significant moderator of objective sleep duration in the meta-analysis by Ruiter and colleagues.[8] Several studies have extended this work to other occupational variables specifically applied to self-reported sleep duration. In a sample of employed individuals from the 2004-2007 NHIS dataset, the difference in short sleep duration (≤ 6 hours) remained, though other occupational variables were not examined.[18] Jackson and colleagues expanded the scope of the NHIS analyses by investigating racial disparities in short sleep duration (<7 hours) by occupation and industry from the 2004 to 2011 survey years.[19] Blacks reported shorter sleep duration more often than whites when they held professional positions, and as professional responsibility increased short sleep increased for blacks but decreased for whites. These data suggest that longer work hours and greater responsibility may contribute to the disparity. In one occupational group, extended care facility workers,

sleep duration was assessed with wrist actigraphy. After adjustment for age, gender, education, and income, the sleep duration difference attenuated from 50.9 to 37.7 minutes when hours worked per week and working the night shift were added into the model.[17]

Neighborhood context such as disorder, segregation, reduced city services, crime rates, crowding, noise level, and exposure to toxins has been proposed as an explanatory factor for black and white differences in sleep duration. Hale and Do suggested that blacks are more likely to live in urban environments than whites, which is also associated with short sleep duration.[12] In a study of black and white community participants residing in the same urban environment, race was not a significant predictor of self-reported sleep duration.[20] This finding suggests when the environment is equivalent, ethnic differences in self-reported sleep duration may no longer be significantly different.

Objective sleep duration, continuity, and architecture.

The literature reporting on objectively-assessed sleep across ethnic groups has been consistent with the meta-analytic evidence. A community-based sample of older men indicated that from one in-home sleep study and five nights of actigraphy, older black men had significantly shorter total sleep time (6.1 vs. 6.4 hours), lower sleep efficiency (80.6% vs. 83.4%), longer sleep-onset latency (28.7 min vs. 21.9 min), and less percentage of Stage 3 sleep (4.9% vs. 8.8%) than older white men.[21] These differences persisted after accounting for social status, medical conditions, body mass index, and sleep-disordered breathing. Sleep-disordered breathing has rarely been accounted for in previous studies, thus it is a substantial strength of this study. A sample of middle-aged, community-dwelling women demonstrated equivalent findings. Over three nights of in-home polysomnography, black women had shorter total sleep time (363.3 min vs. 393.92 min), longer sleep-onset latency (24.5 min vs. 17.5 min), more wake after sleep onset (62.5 min vs. 47.7 min), poorer sleep efficiency (81.0% vs 86.1%), and less Stage 3 percentage (2.5% vs. 4.4%) than white women.[16] They also had reduced delta power (26.3 Hz vs. 29.2 Hz) and heightened beta power (1.8 Hz vs. 1.6 Hz) suggesting cortical hyperarousal. Among a community

based-sample of younger to middle-aged adults, a similar pattern emerged. Blacks had poorer sleep efficiency, greater sleep-onset latency, greater wake after sleep onset, more of Stages 1 and 2 sleep, and less Stage 3 percentage (16.1% vs. 23.7%) than whites, although there was no differences in total sleep time.[22] Mezick and colleagues provide a more comprehensive picture of ethnic differences of sleep from a community-based sample of men and women using nine nights of wrist actigraphy.[23] Shorter sleep duration (blacks: 381.1 min. vs. whites: 416.1 min) and greater intra-individual variability in sleep fragmentation, a measure of nocturnal movement as a proxy for sleep continuity, (blacks: *SD* = 12.4 vs. whites: *SD* = 9.3) were significantly more prevalent in blacks than in whites.

Sleep complaints and sleep quality

The literature on sleep complaints was extensively reported on from the studies included in the meta-analysis on ethnic differences in insomnia symptoms and complaints. However, a few studies published since the meta-analysis further enlighten the results. A large cohort of 159,856 from the Behavioral Risk Factor Surveillance System were asked if over the last two weeks they had trouble falling asleep, staying asleep, or sleeping too much.[24] Similar to the meta-analysis results, black women (OR: 0.74, 95%CI: 0.55-1.00) complained significantly less than white women, though black men did not have significantly less odds of reporting sleep complaints than white men (OR: 0.76, 95%CI: 0.46-1.27). In the 2005-06 NHANES, whites also reported feeling unrested during the day regardless of hours slept compared to blacks (OR: 0.8, 95% CI: 0.7-0.9).[25] In contrast, other studies found that blacks had higher odds of non-restorative sleep (OR: 1.59, 95% CI: 1.25-2.01),[26] more prevalent restless sleep (blacks: 43% vs. whites: 34%),[27] and poorer sleep quality as measured by the Pittsburgh Sleep Quality Index.[16,28,29] Though one study found no differences in the Pittsburgh Sleep Quality Index among older women.[30] These discrepancies may be partly explained by socioeconomic disadvantage. In an unadjusted analysis of community members, poor whites and blacks were both more likely to report poor sleep quality than

whites who were not poor.[31] However, once other socioeconomic indicators and health factors were added to the model, the effect disappeared for blacks and persisted only among poor whites.

Summary

Major strides have been made in the pursuit of identifying and understanding the nature of ethnic differences in sleep between white and black adults. Consistently, ethnic differences in objectively-determined sleep duration, continuity, and architecture have been reported among individuals without sleep disorders, which indicate blacks tend to have shorter sleep, more fragmented and variable sleep patterns, and lighter sleep than whites. Variability in sleep patterns among blacks is further reflected in reports of sleep duration, which reveal that there is a preponderance of both short and long, habitual sleep durations among blacks relative to whites. This greater prevalence of extremes in sleep duration endures despite accounting for confounders such as age, gender, income, education, occupational factors, health behaviors, and comorbidities. The higher prevalence of sleep-disordered breathing among blacks was also apparent though this difference may vary over the lifespan and by gender. Lastly, whites were more likely to utilize sleep medication to treat sleep problems than blacks.

Despite these strong findings, there remain considerable discrepancies in the data on sleep complaints, reported sleep quality, and insomnia symptoms. On one hand, blacks report fewer sleep complaints and insomnia symptoms, yet on the other they report poorer sleep quality, non-restorative sleep, and restless sleep. In addition, the evidence on ethnic differences in sleep apnea severity and the prevalence of other sleep disorders such as periodic limb movement disorder and restless legs syndrome are equivocal and limited. Several other sleep disorders and disturbances also need to be tested for ethnic/racial disparities (e.g., circadian rhythm disorders, parasomnias). Finally, the relative contribution of biopsychosocial factors across the lifespan to these differences is yet to be elucidated.

Methodological differences between the reviewed studies are crucial to consider when interpreting these findings, particularly with the studies on self-reported sleep. Although many of the

studies used large, representative national samples and conducted similar analyses, prospective sleep assessment was not conducted, definitions of short and long sleep duration varied greatly, and the wording of the items was not uniform. Currently there is no standard way to ask participants about sleep duration or sleep complaints. Differently worded or formatted questions may result in mixed responses across ethnic/racial groups. A recent study found that when sleep duration is asked as a single question (i.e., usual sleep duration) compared to two questions (i.e., sleep duration on weekdays and weekends), sleep duration was reported as 15 minutes shorter than with the two question format.[72] This discrepancy increased to about a half hour when comparing blacks with whites. Therefore, some of the differences in self-reported sleep may not be as large in magnitude as currently reported. Future studies should reevaluate the questions and methods of data collection used when investigating sleep across ethnic/racial groups. Assessment instruments ought to be reviewed by focus groups and/or community advisory boards representative of the target populations prior to actual assessment.

Future Research Directions

The reasons for ethnic differences in objective and self-reported sleep duration among individuals without sleep disorders are not well understood. Numerous factors commonly implicated in insufficient sleep have been proposed such as a higher prevalence of socioeconomic disadvantage, medical conditions, and disruptive sleep environments among blacks. Much of the previous literature has not married the quantity of sleep with the quality of sleep and its daytime consequences across ethnic groups to verify whether these quantity differences are experienced as problematic on a day-to-day basis. Are blacks actually sleep deprived, or, on average, do they need less sleep than whites? Are these differences in fact normative? Several studies suggest that these ethnic differences are not normative. Short and long sleep duration are related to greater prevalence and incidence of multiple comorbidities, such as diabetes mellitus,[43] stroke,[44] cardiovascular disease,[45] and obesity,[46] as well as mortality.[47] In general, blacks have a higher prevalence of these medical conditions suggesting that sleep

may contribute to ethnic health disparities. The evidence is growing that sleep may play a significant role in the ethnic disparities in chronic illnesses such as stroke,[48] diabetes,[49] coronary heart disease,[50] and obesity,[51] though the data are not conclusive.[27] Prospective cohort studies should be initiated that routinely measure objective and self-reported sleep, sleep-related consequences, and sleep-related behaviors at each assessment period in concert with incidence of a variety of chronic illnesses. These studies would allow the following questions to be explored: 1) what sleep patterns among blacks are considered normative (i.e., not associated with significant distress and detrimental physiological and psychological consequences), 2) what specified sleep phenotypes beyond the recall of sleep duration are associated with development and incidence of disease across ethnic groups, and 3) what mechanisms explain the relationship between sleep and chronic illness and do they differ by ethnic group.

There are several multifactorial influences on sleep duration and continuity differences by ethnicity/race. However, variables involved in the relationship between race/ethnicity and sleep architecture differences in the proportion of light to deeper stages of sleep has been more elusive. One construct that has received the most attention and evidence is perceived discrimination based on one's race or ethnicity. Perceived discrimination or unfair treatment was related to greater sleep disturbance, complaints, objective sleep continuity and duration,[52-54] but this relationship did not differ by race/ethnicity. However, two studies found that perceived discrimination partially mediated the ethnic differences between blacks and whites on Stage 2 percentage,[22]and slow wave sleep percentage.[22,55] Therefore the effect of perceived discrimination on sleep patterns did not discriminate between ethnic/racial groups, but it does for sleep architecture. Why this construct would not explain ethnic differences in sleep continuity but would for sleep architecture is unclear. Future studies may want to examine these relationships more comprehensively in the context of perceived discrimination as a chronic stressor, which may reveal pathways between the actual discriminatory event, the perception of it, the autonomic nervous system response, and subsequent sleep macro- and microarchitecture.

Absent from the literature on ethnic differences in sleep is assessment of circadian rhythms across ethnic subgroups. Blacks were reported to have shorter circadian clock periods than whites, and they have demonstrated a greater ability to phase advance in response to light with less ability to phase delay relative to whites.[56,57] These data suggest ethnic differences in sleep may be partly influenced by differences in ability to phase advance and delay in response to sociocultural and environmental influences. Such influences may include shift work, and increased social activity in the evenings that delay sleep until later hours than natural. Shorter endogenous circadian periods would interfere with adapting to these activities and may be related to shorter sleep duration among blacks. Studies that assess for circadian period, chronotype, sleep patterns, and behavioral and sociocultural patterns that affect the sleep/wake cycle would illuminate the biobehavioral interactions between these phenomena.

The study of ethnic differences in sleep would benefit from a lifespan perspective. Not only are present stressors contributing to these differences, early influences may also be factors. Childhood adversity may set the stage for sleep disruption and variability in adulthood. Childhood adversities such as frequent fear of a family member and family conflict were related to poor sleep quality in adulthood.[58] Further, childhood adversity was also related to insomnia in later life.[59,60] Mechanisms that bridge these experiences may include alterations in the stress response cycle [61] as well as activation and deactivation patterns of various neurobiological substrates.[62] Blacks may experience more adverse events during childhood, which may lead to a cascade of pathophysiological effects that contribute to risk of disrupted sleep. Longitudinal studies are needed to test these hypotheses. The etiologies of disrupted sleep, insomnia and other sleep disorders may differ by ethnicity/race, which likely would affect the course of clinically significant sleep disturbances over the lifespan and treatment responsivity.

Ethnic differences in early influences on the functionality and responsivity of the sleep/wake cycle may explain objective differences in sleep. However, this hypothesis does not explain the discrepancy between poor objective sleep patterns coupled with poor reported sleep quality among

blacks, yet a reduced likelihood of reporting sleep complaints compared to whites. One socio-ecological model of sleep suggest that multiple factors at the micro- (e.g. individual demographics, health), meso- (e.g., family, occupation, neighborhood, religion and culture), and macrosystem (e.g., society and media) levels can affect sleep duration and quality.[63] Ethnic differences in the experiences at each socioecological level (i.e., society, culture, family, and health) may result in different perceptions, expectations, attitudes, and behaviors related to sleep that may transmit across generations. These ethnically and culturally based experiences may affect how blacks respond to questions about their sleep and how much they value and act on their sleep. Some hypotheses worthy of testing might be: 1) do blacks have beliefs and expectations that poor sleep is common and not a serious problem [64]; 2) do blacks cope or appraise their sleep experience more positively [65]; 3) are their barriers in accurate reporting to physicians and researchers such as mistrust and perceived discrimination; and 4) are current sleep survey items not adequately capturing the sleep experience of blacks?[66]

The field of ethnic differences in sleep is ripe with questions in need of answers. Beyond understanding discrepancies in the known literature, there are several other questions that have rarely been addressed that also warrant attention. We believe there are two major areas of research that have received the least attention yet may offer the best clinical value. The first is the lack of solid explanations for why these sleep differences are present. Mechanistic pathways between ethnicity/race and sleep have often been proposed, but rarely tested with the exception of perceived discrimination. We propose a conceptual model of several biopsychosocial factors that may serve as mediators in this relationship in Figure 1. Similar to previous recommendations,[64] this model is a research agenda for future testing of these factors as mediators rather than solely as covariates or moderating variables. Second, the assumption of treatment access and consistency across different ethnicities has proven untenable in multiple other domains such as hypertension and chronic pain.[67,68] Differences in access and response to evidence-based sleep interventions have rarely been studied. For example, no studies

have investigated ethnic differences in pharmacological and psychological treatment of insomnia. Though a randomized controlled trial of a culturally-tailored, telephone-delivered behavioral intervention to improve adherence to CPAP treatment for obstructive sleep apnea has recently been proposed.[71] Future clinical studies should model this trial's emphasis on tailoring treatment materials to the cultural values and norms of the target ethnic group as well as to investigate perceptions and preferences for sleep treatments (e.g., perceptions of sleep medication) that may be clinically beneficial for providing patient-centered and ethnically-appropriate care

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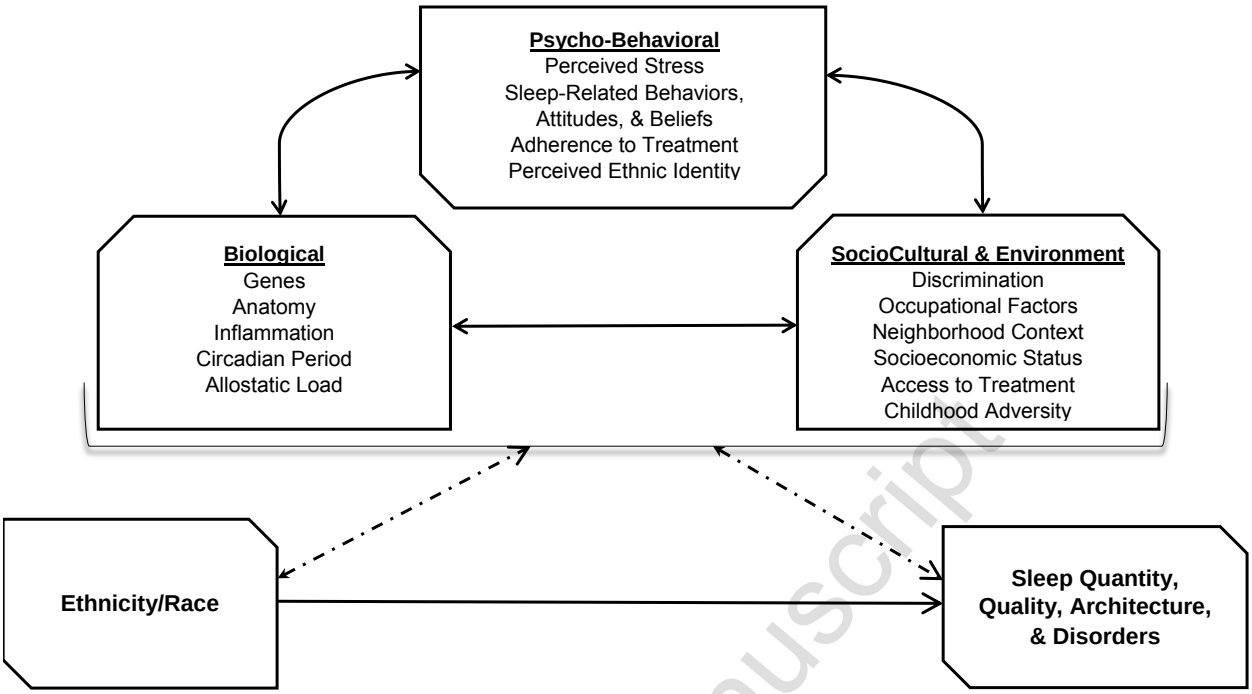

Figure 1. Conceptual model of proposed biopsychosocial mechanisms on ethnic/racial disparities in sleep. This model includes several potential biological, psycho-behavioral, sociocultural, and environmental factors that are proposed to be mediators in the relationship between ethnicity/race and sleep. All of these factors have been reported to be either related to ethnicity/race, sleep, or both. Many of these potential mechanisms are likely inter-related. Solid lines represent relationships indicated in the literature. Dotted lines represent proposed mediating pathways between ethnicity/race and sleep parameters.

Table 1. Effect sizes for objective and self-reported differences in normal and disordered sleep

Variables	Studies, No.	Black No.	White No.	Effect Size (95%CI)	Outcomes
Total Sleep Time					
Objective	8	526	997	-.48 (-.59, -.36)	-28.2 min
Self-Reported	6	738	2,515	-.23 (-.31, -.14)	-15.1 min
Sleep Efficiency	7	524	676	-.54 (-.66, -.42)	-4.4%
Sleep-Onset Latency	6	500	649	.39 (.28, .51)	5.8 min
Stage 2%	6	233	619	.57(.40 .74)	5%
Stage 3%	8	290	690	-.55(-.71, -.39)	-7.6%
Sleep Complaints	9	8,129	10,944	-.23 (-.27, -.19)	AA < NHW
Difficulty Maintaining Sleep	9	18,007	101,815	-.19 (-.21, -.17)	AA < NHW
Early Morning Awakenings	6	13,801	87,119	-.07 (-.09, -.04)	AA < NHW
SDB Severity	8	811	5,371	.10 (.02, .18)	AA > NHW
SDB Prevalence	5	399,996	2,134,886	.13 (.12, .14)	AA > NHW

Note. These data are a summary of findings from two meta-analyses by Ruiter et al., 2010 [7] and Ruiter et al, 2011.[8]

Effect Size = Hedges' *; CI = confidence interval; SDB = sleep-disordered breathing